

their form, composition and arrangement, together with the general characters of their venation, surface and texture; nor has the author omitted to go into the more detailed but equally important consideration of the anatomical structure and physiological functions of leaves. This part also contains many lists comprising those leaves which show the same common features as regards arrangement on the twig, form of venation, character of base, apex and margin of lamina, &c.

Part ii. of this volume, like that of vol. i., gives the classification of trees and shrubs, but, in this case, according to the character of their leaves. A useful glossary is given at the end of the volume, so that the beginner need have no difficulty in understanding the few but necessary technical terms which are used in the book.

ADVANCES IN PHYSICAL SCIENCE.

The Recent Development of Physical Science. By W. C. D. Whetham, F.R.S. Pp. xii+344. (London: John Murray, 1904.) Price 7s. 6d. net.

IT is now nearly thirty years since Prof. Tait published his lectures on "Recent Advances in Physical Science." The period that has since elapsed has been one of remarkable fruitfulness, and it is a suggestive fact that the fundamental problems of physical science which were dealt with by Prof. Tait have to so large an extent supplied the motive for the investigations now described by Mr. Whetham. Foremost amongst these perennial problems must be placed the structure of matter, the mutation of energy, and the nature of comets and nebulae. Lord Kelvin's vortex-ring theory of the atom, so lucidly expounded by Prof. Tait, finds in the later volume its analogue in the electrical or corpuscular atom of Prof. J. J. Thomson, and the doctrine of the conservation of energy, which occupies the foremost position in the earlier volume, is again brought into prominence by the recent suggestions that the internal motion of the atom, be it that of a vortex ring or of a moving electron, may perhaps be drawn upon to supply the energy that is liberated from some hidden storehouse by the radio-active elements.

After an introductory chapter on the philosophical basis of the science, Mr. Whetham devotes two chapters to the liquefaction of gases and the phenomena of fusion and solidification. These two chapters afford striking examples of the way in which recent years have added to the equipment of the experimental sciences, not only by increasing the range of temperatures within which investigations may now be conducted, but also by providing the means of accurately measuring these temperatures. Under the heading of "Fusion and Solidification" Mr. Whetham has given a concise and readable account of the knowledge recently acquired with reference to the structure of metals and alloys. The examples, already classical, of the copper-tin alloys studied by Roberts-Austen and by Heycock and Neville, and the iron-carbon alloys studied by Osmond, le Chatelier, Roberts-Austen, and others are described. Photomicrographs of the former

series of alloys are given. The most fascinating part of the chapter, however, is that which deals with Mr. Beilby's recent investigations of the surface structure of solids. These investigations have shown that even a brittle metal like antimony can be made at ordinary temperatures to flow like a liquid, so that when it is rubbed with fine emery paper the surface produced is not jagged or crystalline, but under the highest magnification appears rather like a freshly painted surface on which the rounded streaks left by the brush are still visible.

In the chapter on the problems of solution, the mechanism of electrolysis is discussed from the point of view of Arrhenius's theory of electrolytic dissociation, but the arguments in favour of this theory are stated with a moderation that is in marked contrast to the one-sided statements that have sometimes been put forward by ardent supporters of the theory. In considering the nature of colloidal solutions, a purely physical explanation is given of the coagulation of the proteids; the observation that "the direction of movement of certain proteids" under the influence of an electric current "could be changed by changing the solvent from a very dilute acid to a very dilute alkali" would be interpreted by the chemist as evidence of their power, as amino-acids, to function either as acid or as base, whilst the fact that "if the solvent was very carefully neutralised an isoelectric point was reached at which the solution became very unstable and coagulation seemed to occur spontaneously" would be ascribed to the tendency of the free amino-acid to condense and form a more complex molecule in the manner characteristic of this group of compounds.

The chapters on the conduction of electricity through gases and on radio-activity contain a concise account of the series of investigations that have been co-ordinated in the recently published works of Prof. J. J. Thomson and Prof. Rutherford. The chapter on atoms and æther derives its chief interest from the inclusion in it of the results of Prof. Thomson's recent investigations of the stability of a system of negatively charged corpuscles revolving in orbits within a positively charged sphere. The atomic model suggested by such a system gives, probably for the first time, a clear representation of the periodic properties of the elements, including the variation in valency, which is the most characteristic of these properties.

The final chapter, on astrophysics, contains an account of the more recent results of spectroscopic investigations of the sun and stars, and includes reproductions of three of the most striking of Prof. Hale's solar photographs. In the later part of the chapter the pressure due to radiation is considered and applied to the explanation of the curious phenomena of comets' tails, whilst the mutual repulsion of radiating particles is suggested as a possible explanation of the permanence of Saturn's rings.

The author has sought to express the results of recent physical investigations in a form which "might prove useful to students of science in general," and "also appeal to those who, with little definite scientific training, are interested in the more important conclusions of scientific thought." In the former part

of his task he has been eminently successful. In his appeal to a wider public, it is to be hoped that the difficulties of "treating the wider and deeper generalisations of natural science as fit subject-matter for current thought and literature" will not deprive him of a further measure of well merited success.

T. M. L.

THE CYANIDE PROCESS.

Cyaniding Gold and Silver Ores. A Practical Treatise on the Cyanide Process; embracing Technical and Commercial Investigations, the Chemistry in Theory and in Practice, Methods of Working and the Costs, Design and Construction of the Plant and the Costs. By H. Forbes Julian and Edgar Smart. Pp. xx+405; illustrated. (London: C. Griffin and Co., Ltd., 1904.) Price 21s. net.

THE cyanide process is still in its teens, but it is a lusty stripling. Much of the enormous increase in the production of gold during the last few years is due to it, either directly or indirectly. There are few gold mines of any importance in the world at which the process is not installed, and it has been stated on high authority that the majority of these mines could not earn profits and pay dividends without its aid. Owing to the shortness of the time since the industry of cyaniding gold and silver ores began to spring up, there is a lack of data on the subject readily available to men at work far from centres of civilisation. There are many books on the cyanide process, but new ones are still welcome, particularly a work like that of Messrs. Julian and Smart, in which some degree of completeness is attained.

The authors were well equipped for their task, both having been engaged in the industry for a number of years. They have not, however, merely written down the results of their own practical experience, a course which usually leads to dogmatic assertion on doubtful points, but, on the contrary have studied the voluminous literature of the subject with evident care, and displayed some judgment in their extractions. If they had added a bibliography, one shudders to think of the portentous length it would have attained.

Not content with this, they have made a number of laboratory experiments on the dissolution and precipitation of gold, and advance views based on these which are in part novel and somewhat unsatisfactory. Exception may fairly be taken to this portion of the book, for whether these views are right or wrong, they are out of place in a text-book until they have been discussed adequately. To the practical worker, for whom this book is intended, theories are useful only if they explain and elucidate phenomena with which he is confronted in the mill, or enable him to decide on a course of action in unusual cases. Much of the authors' theorising does not appear to answer this test very well.

The book begins with an interesting, if not an impartial, chapter on the early history of the cyanide process. The authors next proceed to describe the laboratory experiments which are necessary to deter-

mine the method of applying the process to any particular ore. In the useful discussion on sampling, the omission of any reference to recent work is noticeable, and the account of automatic machines is hardly adequate.

The most serious omission in this section, however, is in regard to laboratory work in connection with a mill in operation. The examination of mill solutions for gold and other metals, for available cyanide, for oxygen, or for dissolving power is not touched on. The only reference to the matter is in the sentences:—

"It must however be understood that there is no relation between the (total cyanide) found present and the dissolving action of the solution on gold and silver. For this reason two different solutions containing by the test the same quantity of cyanide may have very different dissolving effects."

This would be cold comfort to anyone who wished to learn what he could of the methods adopted to determine the condition of a mill solution. The gap should be filled in a future edition.

The later chapters, dealing with the methods and machinery used in practice, form by far the most interesting and useful part of the book. The authors seem to be quite at home in describing the design and construction of leaching vats, precipitation boxes, pumps, launders, sizing plant, and all the accessories of a modern cyanide mill. The methods of treating different classes of material are also handled with skill and judgment, and are fairly up to date. It is not the fault of the authors that progress in the industry continues to be rapid, and that any description is behind the times almost as soon as it is printed. The book ends with a couple of excellent chapters on the cost of constructing plants and of treating ores, and the index has been carefully prepared.

The volume is handsomely got up, and enough has probably been said to show that the merits of the work so far outweigh its faults that those interested in the cyaniding industry cannot do without it.

T. K. R.

OUR BOOK SHELF.

Fireside Astronomy. By D. W. Horner. Pp. 105. (London: Witherby and Co., 1904.) Price 1s. 6d. net.

"THE articles which go to make up this little book originally appeared in the 'English Mechanic and World of Science,' and caused some discussion therein." This we read in the preface of the book before us, and we are further told there that this "simple worded treatise" is intended for the "man in the street."

A perusal of these pages will, however, tend to bewilder the mind of this very practical personage considerably, for the text is not a specimen of clearness, and the illustrations are very far from being self-explanatory; in fact, the latter are as bad as it seems possible for illustrations to be.

In justification of these statements it may be remarked that the zodiac is mentioned on p. 3 and defined on p. 14. On p. 4 we have a very ambiguous statement about the various altitudes of the sun at different seasons of the year, no reference being made